THE NATIONAL COLLEGE OF ART AND DESIGN

A BRIEF HISTORY OF THE DESIGN DEVELOPMENT OF THE WHEELCHAIR AND INVALID FURNITURE FOR THE COMFORT AND MOBILITY OF THE DISABLED

A thesis submitted to:

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TABLE OF CONTENTS

Page No.

LIST OF ILLUSTRATIONS

TABLES

Important Dates in the Development of the Wheelchair

1096 - 1291	The Crusades
*c. 1550 - c.1750	Renaissance Period
1643 - 1715	Louis XIV Period
1714 - 1820	Georgian Period
1715 - 1835	W. Pocock - Wheelchair Maker
1751 - 1835	Sheraton Period
1776 - 1783	American War of Independence
1796 - 1815	Napoleonic Wars
*c. 1780's - 1830's	Industrial Revolution
1800 - 1830	Regency Period
1812 - 1815	American War with Great Britain
1820	Robert Daws, first registered as Upholsterer Cabinet and 'Patent' Chairmaker
1830 - 1901	Victorian Period
1861 - 1865	American Civil War
1870 - 1871	Prussian War
1899 - 1902	Boer War
1901 - 1910	Edwardian Period
1914 - 1918	World War I
1939 - 1945	World War II

Table 1 Important dates in the development of the Wheelchair.

Note: * Dates given in these cases can only be taken as approximations as both transitions were gradual and did not happen suddenly. The dates were considered, bearing in mind the influence they had on the development of the wheelchair.

INTRODUCTION

The history of the wheelchair and invalid furniture is a complex and interesting, but as yet, little documented subject. Until the turn of the eighteenth century, when the application of mechanical devices to furniture produced an abundance of 'patent' chairs, sofas and beds, little consideration appears to have been given to the comfort and mobility of invalids.

Before the eighteenth century the history of invalid furniture had concentrated largely on mobility in portable and wheeled chairs. For this reason the paper has been divided into two main parts: Pre and Post Industrial Revolution design development. A table of important dates in the development of the wheelchair has been included for convenience, Table 1, p.1.

Early carrying chairs were based on the universal principle of the stretcher, and their appearance depended largely on the affluence of its occupant. Designs varied from elaborately covered sedan chairs to the simple litter. This principle was still well used into the nineteenth century with appearance changing over the years in accordance with the general style of furniture.

The introduction of the wheelbarrow to Europe around the twelfth century and later the development of a third and smaller swivelling wheel attached to a steering rod led to the development of the Bath chair. Application of mechanical devices; increased medical knowledge and ergonomic awareness; population increases; wars; simplification and reduction in the number and complexity of essential parts; construction of wheels large enough to be turned by the user; all contributed significantly to the development of the lightweight and collapsible wheelchair commonly seen today.

PART I

PRE-INDUSTRIAL REVOLUTION DESIGN DEVELOPMENT OF THE WHEELCHAIR

Development of the Wheeled Vehicle

Man's earliest land vehicle was probably the sledge under which were placed log rollers. Later discs were cut from the tree trunks and attached to logs of somewhat smaller diameters: hence the revolving axle. Presumably the next step was a crude cart-type vehicle possessing a stationary tree trunk axle on which attached wheels could revolve. The construction of any such vehicle would need to have been sturdy and would have related directly to the kind of roads at the time. Roads would have been little more than animal paths, muddy dirt tracks or barren fields and forest clearings.

There is archeological evidence which suggests that both the ancient Egyptians and Assyrians built some chariots of fairly advanced construction. A typical chariot comprised two wheels held in place by wooden pins in the axle and a box open at the rear. Holes were burnt into the wooden parts to permit the passage of thongs used for binding these parts together. The system was initially developed by the Greeks but was imitated by the Romans.

The Litter

Although wheels and chairs were known in pre-Christian times, possibly as far back as 3500 B.C. in the near East[1] the sick and the disabled were generally transported in a recumbent position. The vehicle for those who could not, or chose not to, walk was the litter. Defined as a portable bed or couch open or closed, mounted on two poles and carried at each end on men's shoulders or by animals[2], they have hardly changed through history. Litters, which were probably adapted from sledges, appear in Egyptian paintings and were used by the Persians. They were common in the Orient

where they were called 'palanquins'; and in ancient Rome a litter was a visible symbol of status as they were reserved for empresses and senators' wives and their use by plebians was forbidden.

As they were light, simply constructed and easily carried by slaves, servants, soldiers or members of the family, it was the ideal means for bearing the sick and the lame. This method of carrying also overcame the roughness of the ancient roads and the shocks of unrefined carriages. Litters were used extensively for the wounded in battle and Tiberius in his Illyrian campaign in 9 A.D. had a corps specifically for litter bearing.

Greek and Roman physicians prescribed for various diseases, transportation by litters, swings, cradles and sedan chairs - sella gestatoria in Rome - but there is little evidence of the use of wheeled chairs or litters in those days.

Early Examples of Indoor Vehicles

The earliest known representations of an indoor vehicle may be that of a child's bed pictured on a Greek vase from the sixth century B.C., (Fig.1) whereas an incised stone sculpture one thousand years later might be the oldest representation of a wheeled chair. It comes from China, the only country of the eastern half of Asia in which chairs were used before modern times [3], and is dated about 525 A.D. Now in Kansas City, Missouri, two stone slabs of a sarcophagus are decorated with scenes from the Confucian Stories of Filial Piety. On one of them a youth holds a litter for his grandfather who sits next to him on the ground. But more important for this history is an object pictured on the other slab, a chair on three wheels, not unlike some of the wooden garden chairs on wheels today.
See simplified illustration, Fig.2.

Fig 1 Child's bed on rollers
From a hydria, Ionian made
c. 530 B.C. found in Caere,
Etruria.

Fig.2 Simplified illustration of a detail
from a Chinese sarcophagus, incised
black stone, c.525 A.D.

The Wheelbarrow

A simple vehicle that has remained universally popular from the Middle Ages until today for its efficiency in transportation is the wheelbarrow, also from China. It is presumed to have been invented in the third century A.D. and came to Europe by route of the Crusades [4] in about the twelfth century. In a painting by Lucas Cranach in 1546 (Museum Berlin - Dahlem), he shows the old and disabled brought for rejuvenation on men's shoulders, in litters, in horsedrawn carriages, or in wheelbarrows to the magical Fountain of Youth.

For invalids who could sit, little carts with two large wheels to be pulled or pushed are shown in several engravings of the early sixteenth century by Hans Burgmair. Children also used different types of small carts. These three-wheeled vehicles were either used as walkers for the younger children or as scooters using one foot to propel the vehicle.

Development During the Renaissance

During the Renaissance small wheels or rollers were put under many pieces of the heavy upholstered furniture. The main reason was not for easy transportation of persons, but of the chairs themselves. These rolling chairs often incorporating a back reclining on a ratchet, head wings, arm rests etc., were made for individual cases and sometimes for the use of the maker himself.

A particular example of such a chair was that of Philip II, King of Spain (1527-98) and was designed by a Flemish nobleman in his service, Johan Lhermite, (Fig.3). It was built in 1595 and a detailed description, partly in French and Spanish, of the King's 'Gout Chair' along with several pen drawings are to be found in his memoirs [5]. As can be seen from the illustration it moved on four small wheels, had a reclining back and an elevated leg rest with footboard, several features seen in invalid chairs built three centuries later. The arms could be reclined laterally and the back and leg rest were

Fig.3 King Philip II of Spain, in his rolling chair. Pen drawing, 1595, from Lhermite.

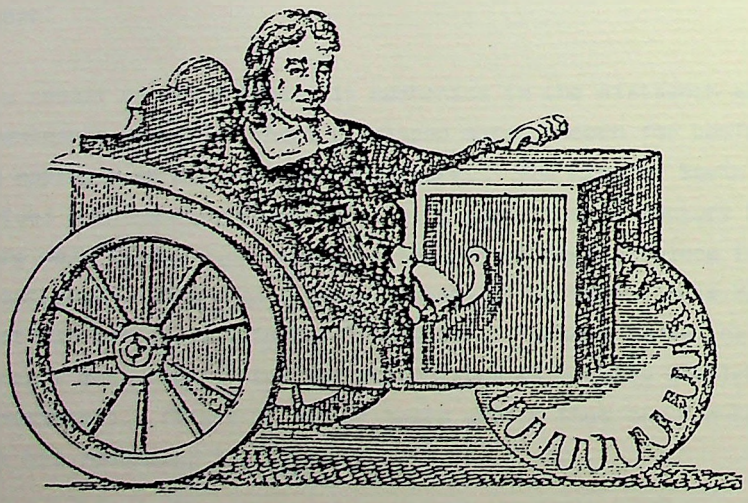


Fig.4 Self Propelled chair, built c.1655 by Stephan Farfler.

fixed in various positions using curved metal bars with notches. The chair was covered with a horse-hair mattress and,'though it was but of wood, leather and ordinary iron, was worth ten times its weight in gold and silver', for His Majesty's comfort. (Quote also found in Lhermite's memoirs).

It was in this atmosphere when Leonardo had various devices for motion, Michelangelo had captured movement in marble and paint and Galileo had described the motion of planets, that the construction of mechanical chairs and other means of transportation became a challenge to craftsmen and princes alike.

For easy travelling from one floor to another, Jean-Jacques de Renouard, Count of Villayer, invented the 'chaise volante', the flying chair, which was a simple chair travelling in a shaft and attached to a rope which passed over a pulley to a lead counter-weight. The fame of its inventor, had it not been for La Bruyere, his contemporary, who built him an everlasting memorial in the personage of 'Ergipe', one of his characters, would have ended following an unfortunate incident when the Duchesse de Bourbon, using one of these chaises volantes, stopped midway between two floors!

As a result of the interest in mechanics in the sixteenth and seventeenth centuries there developed some concern for comfort at the approach of the eighteenth century. The King of Spain had derived such comfort from his rolling chair that a century later there were twenty such chairs at the French King's Palace in Versailles. After his 'grande operation' in 1686, Louis XIV, spent his entire days in his 'roulette'. (Hence today one of France's most popular tourist attractions is totally wheelchair accessible!) It was in one of these chairs that the Sun King took his last meal in 1715.

Revived in the Renaissance, the interest in bodily contours expanded from Rubens to Boucher and from the nude body to its coverings and surroundings. Evidence of this thinking can clearly be seen in the

furniture of that time, rounded, stuffed and large, these chairs welcomed their guests and adapted their form to those of the human body. Due to their weight small casters, so as not to disturb the general lines of design, were attached to facilitate easier change of location. However, these chairs still required an assistant.

For self-propulsion more sober designs were needed. In Nuremberg, as early as 1588 Balthasar Hacker made a chair on wheels that could be converted into a bed and also used as a commode. Johann Hautsch built several self-propelled chairs in the 1640's, mostly for persons suffering from gout in their feet.

One particularly amusing and interesting design is that of Stephan Farfler, a paraplegic watchmaker from Altdorf, who built a solid low vehicle for himself in 1655. The choice of mechanism to turn the wheels is certainly no coincidence: faithful to his trade, he used cogwheels turned by two cranks, (Fig.4) Later a chair made by Lavocat, France in 1784 was moved by means of endless spring. It was maintained that a six year old could easily operate it. The chair could turn in a circle of four feet in diameter and the mechanism of the chair animated little figurines moving on a writing board!

Dupin - Inventor of the Brouette

Despite all these various contrivances, the carrying chair could not be fully replaced as a lightweight, easily constructed and simple carrying vehicle that due to its method of carrying overcame the rough, unpaved and muddy roads of the time. For short outdoor travels it was still the simplest of all vehicles but the main inconvenience was the necessity of two carriers. However in 1669 Dupin took an important step by replacing one of the two footmen by a pair of wheels, changing the sedan chair to a wheeled barrow. Assalini, at the beginning of the nineteenth century, applied the same transformation to the litter and used it extensively on the battlefield - the design incorporated an adjustable back support for

lying or sitting.

Dupin's two-wheeled barrows, the brouettes, were later called vinaigrettes as they resembled a cart used for carrying casks of vinegar. They were used very much in the seventeenth and eighteenth centuries in France and England and elsewhere as late as the middle of the nineteenth century in Northern France. During the long life of the brouettes many minor modifications developed. Many retained the enclosed sedan chair, whereas others were open at the front. But perhaps the most significant development that evolved was that of a third, smaller and swivelling wheel which served in keeping the carriage always horizontal. This modification is considered to be the main contributing factor to the later development of the Bath chair.

PART II

POST INDUSTRIAL REVOLUTION DESIGN DEVELOPMENT OF THE WHEELCHAIR AND INVALID FURNITURE

The Change from Craft-based to Mechanically-based Production Systems

The Industrial Revolution brought with it many traumatic changes to a formerly traditional and craft-based production system. Mechanisation opened up many new markets for textiles, furniture and other products. It became easier and cheaper for the manufacturers of mass-produced goods to copy products previously confined to the wealthy and aristocracy and make many products available to the expanding middle classes.

Because it was then believed possible to 'improve' on the work of the artist-craftsman, and considering it was also possible to turn out elaborate designs in astonishing quantities, it is an interesting period in history to examine almost any product. The results of many of these productions, to our present way of thinking, were unacceptably vulgar and a travesty of all that had been achieved by the artist-craftsman of former times. Gone were many of the subtleties and the innate and 'common sense' feeling that stemmed quite naturally from craft-based products. It was also amid this change that there was a call for an injection of art into industry and hence the origin of industrial design.

The Bath Chair

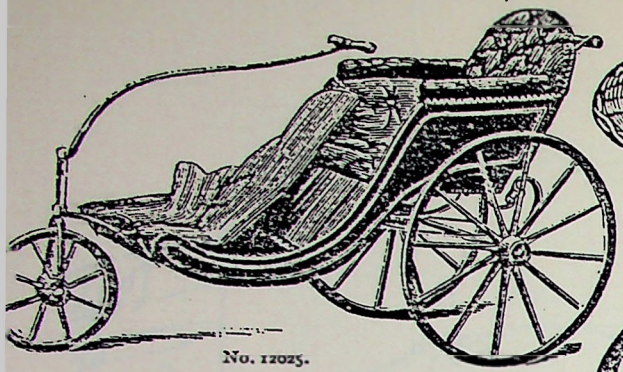
The Bath chair (see Dupin - inventor of the brouette, p.9) was developed at the English spa, of that name, at the end of the eighteenth century and its invention attributed to John Dawson, who in 1798 called himself 'Wheel-chair Maker' [6].

The popularity of Bath as a spa town to which so many invalids journeyed assured him of good business and it was not long before makers in other spa towns, producing similar chairs coined his new name and designs.

The typical Bath chair had two large wheels in the rear and a footrest set behind a third and smaller wheel at the front, and a collapsible canvas hood which could be raised in bad weather. A metal rod attached to the front wheel provided a steering rod for the occupant, while the footman pushed from the back, or alternatively, a handle by which the chair could be pulled along. Framework and wheels were generally of iron although a series of drawings by the caricaturist, Thomas Rowlandson, titled Comforts of Bath, 1798, show fine examples of these chairs with solid wooden wheels. The users of these chairs would have, almost without exception, belonged to the upper and more wealthy classes only.

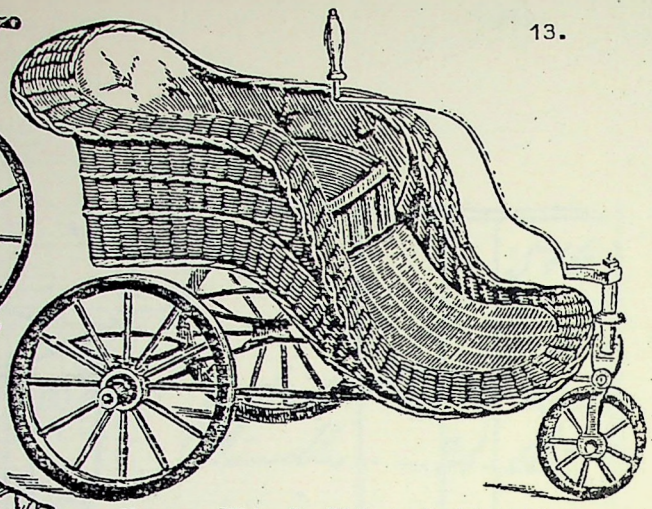
While the Bath chair was for outdoor use, mostly on the urban paved streets and courtyards of the time, the experience in the use of the midline swivelling wheel, together with the development of craftsmanship and reduction to essentials, led to the construction of chairs with wheels large enough to be turned by the seated person, without any intervening chains, cranks or other devices. It was widely recognised that this design would serve many patients, and one such chair, its swivelling wheel in the rear, is shown in a collection of medical instruments of 1766. These chairs, recurring in Thomas Rowlandson's indoor and outdoor scenes appear to be the antecedents to the wheelchairs used today. Evidence was found in five of the twelve drawings of his series 'Comforts of Bath' dated 1798.[7] It changed from wood to wicker and back to wood, made two footboards out of one, added a hood and later dropped it, put large wheels in the front, or changed one front wheel to two, made itself smaller and the wheels larger so that they could be turned by the occupant. The end result is a chair such as appears in a photograph of a ward of a Washington hospital at the time of the Civil War. Similar examples of this type of chair can be seen in an advertisement in a trade catalogue of Silber & Fleming from the 1880's for 'Improved Invalid Carriages, Self-Propelling Chairs and Bath Chairs' (Fig.5).

The existence of specialist wheelchair makers in spa towns at the end of the eighteenth century is understandable but examples elsewhere must have been rare. Most probably chair and cabinet makers were commissioned for individual orders. The records of Gillow of



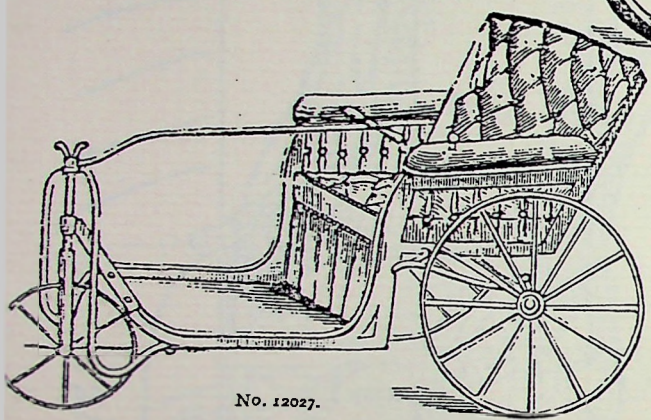
No. 12025.

No. 12023. Invalid Carriage, medium size, upholstered in American cloth, with apron complete, £6 each.
No. 12024. As No. 12023, but with guide handle, £7 10/ each.
No. 12025. As No. 12024, *see engraving*, £9 each.
No. 12026. As No. 12024, but superior cloth lined, £10 10/ each.



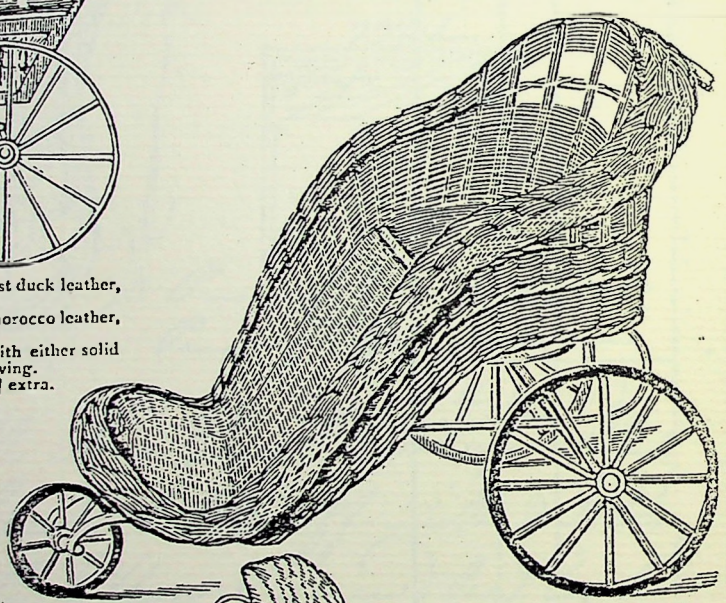
No. 12034. Wicker Invalid Chairs, lined in best leather, small size, 80/; middle size, £5; full size, £6 each.

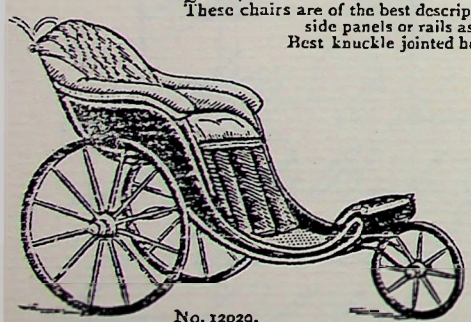
These chairs are made with good bodies of the best buff osiers, they are substantial and well finished, best coach wheels, and steel elliptic springs, good frame, guide rod, and duck leather aprons.



No. 12027.

No. 12027. Bath Chair, upholstered in best duck leather, £14 10/ each.
No. 12028. Bath Chair, upholstered in morocco leather, £16 10/ each.
These chairs are of the best description, with either solid side panels or rails as engraving.
Best knuckle jointed hood, 60/ extra.

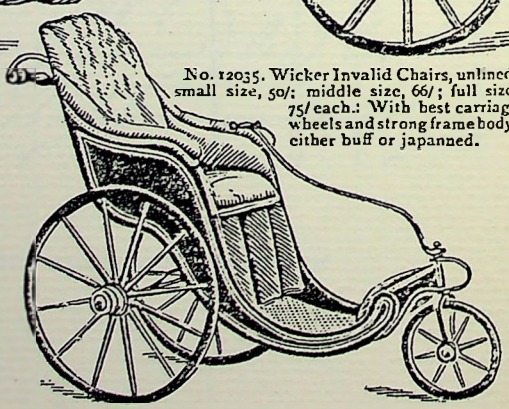




No. 12029.

No. 12029. Improved Invalid Carriage, small size, to suit a child from six to twelve years of age, 90/ each.

No. 12030. As No. 12029, but middle size, to suit youth from twelve to sixteen years of age, £5 10/ each.
No. 12031. As No. 12029, but large, to suit an ordinary sized person, £6 10/ each.
No. 12032. As No. 12029, extra large, to suit a tall or heavy person, £7 15/ each.
If upholstered in good carriage cloth or rep and carriage leather apron, 40/ and 50/ each extra. This carriage being especially low the invalid can get in or out without exertion.



No. 12035. Wicker Invalid Chairs, unlined, small size, 50/; middle size, 66/; full size, 75/ each. With best carriage wheels and strong frame body, either buff or japanned.

No. 12033. Self-propelling Chair, made and finished in the most substantial manner, from £7 15/ to £9 15/ each.

SILBER & FLEMING,

Wood Street,

LONDON, E.C.

No. 12036. Improved Invalid Carriage, one of the most comfortable made, with first-class wheels, best steel springs, guide rod, neatly painted and upholstered with best duck leather, small size, 96/; middle size, £6 10/; large size, £7 5/; extra large, £9 each.
If upholstered in carriage cloth and leather apron, 40/ and 50/ each extra. Knuckle-jointed Hoods, 50/ and 65/ extra.

Fig.5 Page from a trade catalogue of Silber & Fleming, 1880's

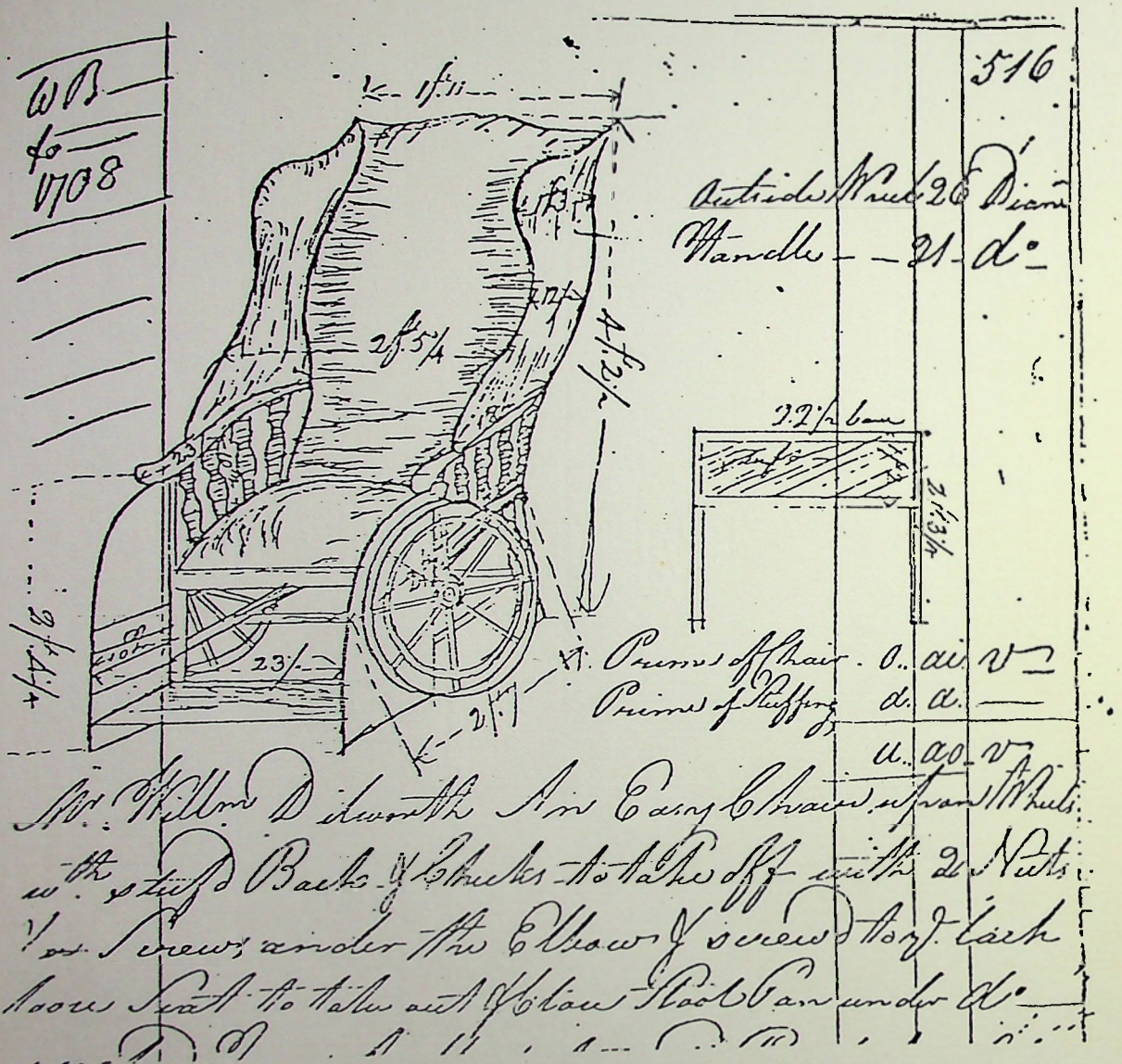


Fig. 6 Design for 'Gouty Chair' from the records of Gillows of Lancaster, March 1787.

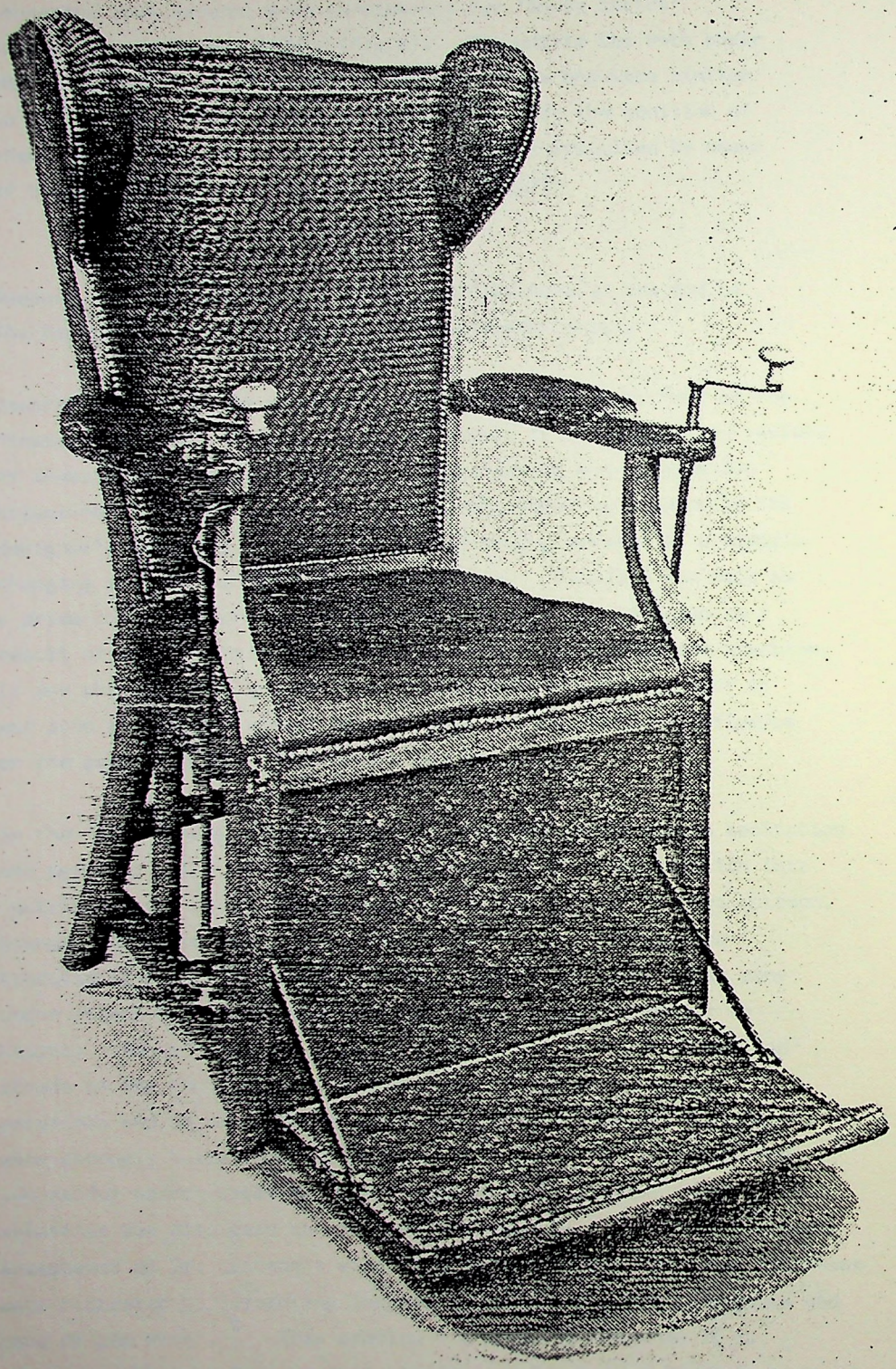


Fig.7 A Mahogany 'Gouty Chair' on brass wheels of c.1800. The horsehair upholstery and carpet on the footrest are original.

Lancaster show several such commissions for 'Gouty Chairs' during the 1780's and 1790's (Fig.6). But unlike the Bath chair these wheelchairs were primarily for indoor use and were similar to the standard elbow chairs of the period, with the addition of wheels and a footrest. Many chairs were self-propelled by means of the two cranking handles on the arms (Fig.7).

Reasons for the Rapid Growth in Invalid Furniture at the End of the Eighteenth and Beginning of the Nineteenth Century

Towards the end of the eighteenth century and the first half of the nineteenth century there was a steady growth in the number and variety of invalid furniture available. An interesting and progressive selection of English furniture existed incorporating a sense of the designer's awareness of the new and challenging demands of a rapidly changing society and readiness to meet them. Function was held as a prime consideration. Much of this furniture was produced as a result of the considerable advances in medical knowledge and practice. It was primarily designed for use in the home although much of it was also adapted for normal domestic use and had distinct influence on the general design of furniture and upholstery.

In the 1790's there was also a greatly increased interest in sanitation and personal hygiene which was largely due to the investigation into 'putrid fevers' by Dr. John Hunter and to the work of Doctors Lettson, Stanger and Rowley among the London poor.[8] In the home the traditional wooden bedsteads, the four-poster and stump beds, came under attack for 'harbouring vermin', with consequent danger to health. Hence began the revolution which led to the standard bedsteads of the Victorian era. Furniture upholstery, bedding materials and in particular, the sacking used in humbler households, were strongly suspect as a carrier of disease and a determined and successful search began for more hygienic substitutes. Much closer attention was also paid to the care of invalids. There was a growing acceptance of Dr. Lettson's view (expressed in 1775) that most illnesses were mitigated by 'promoting instead of restraining the indulgence and care of the sick'.[9] This problem - a pressing one when it is remembered that as late as 1814, Tiffin and Son held a Royal Appointment

as Bug-Destroyers to His Majesty[10] - can perhaps be more fully appreciated having read some amusing extracts from his writings on the insects' habits:

> "The bite of the bug is very curious. They bite all persons the same, but the difference of effect lays in the constitution of the parties. I've never noticed that a different kind of skin makes any difference in being bitten. Whether the skin is moist or dry it don't matter. Wherever buts are, the person sleeping in the bed is sure to be fed on, whether they are marked or not; and as a proof, when nobody has slept in the bed for some time, the bugs become quite flat: and, on the contrary, when the bed is always occupied, they are round as a 'ladybird'.
>
> The flat bug is more ravenous, though even he will allow you time to go to sleep before he begins with you; or at least until he thinks you ought to be asleep. When they find all quiet, not even a light in the room will prevent their biting; but they are seldom or ever found under the bedclothes. They like a clear ground to get off, and generally bite round the edges of the nightcap or the nightdress. When they are found in the bed it's because the parties have been tossing about, and have curled the sheets round the bugs.
>
> The finest and fattest bugs I ever saw were those I found in a black man's bed. He was the favourite servant of an Indian general. He didn't want his bed done by me; he didn't want it touched. His bed was full of 'em, no bee-hive was ever fuller. The walls and all were the same, there wasn't a patch that wasn't crammed with them. He must have taken them all over the house wherever he went.
>
> I've know persons to be laid up for months through bug-bites. There was a very handsome fair young lady I knew once, and she was much bitten about the arms, and neck, and face, so that her eyes were so swelled up she couldn't see. The spots rose up like blisters, the same as if stung with a nettle, only on a very large scale. The bites were very much inflamed, and after a time they had the appearance of boils.
>
> Some people fancy, and it is historically recorded, that the bug smells because it has no vent; but this is fabulous, for they have a vent. It is not the human blood neither that makes them smell, because a young bug who has never touched a drop will smell. They breathe, I believe, through their sides; but I can't answer for that though it's not through the head. They haven't got a mouth, but they insert into the skin the point of a tube, which is quite as fine as a hair, through which they draw up the blood. I have many a time put a bug on the back of my hand, to see how they bite; though I never felt the bite but once, and then I suppose the bug had pitched upon a very tender part, for it was a sharp prick, something like that of a leech-bite".[11]

Tiffin declared, in an interview with Henry Mayhew, that his firm traced its history to 1695, when one of his ancestors, a lady's stay-maker, invented a compound which was so successful that it changed his trade. He also appeared to be an ingenious character:

> "At the time of the illumination for the Peace, I thought I must have something over my shop, that would be both suitable for the event and to my business; so I had a transparency done, and stretched on a big frame, and lit up by gas, on which was written-
>
> MAY THE
> DESTROYERS OF PEACE
> BE DESTROYED BY US.
>
> TIFFIN & SON,
> BUG-DESTROYERS TO HER MAJESTY."

For the most part his interview reveals more of his character than his methods:

> "I mostly find the bugs in the bedsteads. But, if they are left unmolested, they get numerous and climb to the tops of the rooms, and about the corners of the ceilings. They colonize anywhere they can, though they're very high-minded and prefer lofty places. Where iron bedsteads are used the bugs are more in the rooms, and that's why such things are bad. They don't keep a bug away from the person sleeping. Bugs'll come, if they're thirty yards off.
>
> I knew a case of a bug who used to come every night about thirty or forty feet - it was an immense large room - from the corner of the room to visit an old lady. There was only one bug, and he'd been there a long time. I was sent to find him out. It took me a long time to catch him. In that instance I had to examine every part of the room, and when I got him I gave him an extra nip to serve him out. The reason why I was so bothered was, the bug had hidden itself near the window, the last place I should have thought of looking for him, for a bug never by choice faces the light; but when I came to inquire about it, I found that this old lady never rose till three o'clock in the day, and the window-curtains were always drawn, so that there was no light like.
>
> Lord! yes, I am often sent for to catch a single bug. I've had to go many, many miles - even 100 or 200 - into the country and perhaps catch only half-a-dozen bugs after all; but then that's all that are there, so it answers our employer's purpose as well as if they were swarming.
>
> I work for the upper classes only, that is, for carriage company and such-like approaching it, you know. I have noblemen's names, the first in England, on my books.
>
> My work is more method; and I may call it scientific treating of the bugs rather than wholesale murder. We don't care

> about the thousands, it's the last bug we look for, whilst your carpenters and upholsterers leave as many behind them, perhaps, as they manage to catch". [12]

Further examples of the 'creatures' activities are found in letters written by Jane Welsh Carlyle to her husband in the nineteenth century. Although apparently a little neurotic and dramatic about many things, and in particular about servants and bugs, her account is nonetheless fairly horrific. This excerpt is taken from a letter written after bugs were found in the servants' quarter:

> "Only fancy, while I was brightening up the outside of the platter to find in Helen's bed a new colony of bugs! I tell you of it fearlessly this time, as past victory gives me a sense of superiority over the creatures. She said to me one morning in putting down my breakfast, 'My! I was just standing this monring, looking up at the corner of my bed, ye ken, and there what should I see but two bogues! I hope there's na mair'. 'You hope?' said I immediately kindling into a fine phrenzy; 'how could you live an instant without making sure? A pretty thing it will be if you have let your bed get full of bugs again!' The shadow of an accusation of remissness was enough of course to make her quite positive. 'How was she ever to have though of bogues, formerly? What a thing to think about! To be sure, these two must have come off these Mudies' shawls!' I left her protesting and 'appealing to posterity' and ran off myself to see into the business". [13]

And on another occasion while staying in a boarding house in Ryde in 1843, she wrote to her husband:

> "I slept, mercifully, not well, but some. On looking, however at my fair hand in the morning, as it lay outside the bedclothes, I perceived it to be all - 'what shall I say?' 'elevated into inequalities', 'significant of much'! My pretty neck, too, especially the part of it Babbie used to like to kiss, was all bitten infamously .... I went this morning (while a man was taking down my bedstead to look for the bugs, which were worse last night, of course, having found what a rare creature they had got to eat) and investigated another lodging ... in a beautiful little garden, villa-wise, rejoicing in the characteristic name of Flora Cottage. ... God knows whether there be bugs in it....And now, dear, if you think my letter hardly worth the reading, remember that I am all but-bitten and bedevilled". [14]

Apart from casting unfamiliar light on household management, particularly

as it concerns furniture at this time, it also helps a little towards placing the period in proper perspective. To call it an 'age of elegance' is to speak half-truths.

The long French wars (1793 - 1815) provided another opportunity for furniture makers, for there were large numbers of wounded and disabled men to look after, and for their special needs various kinds of ingeniously contrived pieces of furniture were made. The wars also led to much travelling, at home and abroad, by army and navy officers and government officials, often with their families. Portable furniture, easily dismantled for packaging, or containing special storage for household goods in transit, was ideal in these circumstances. Also as Sheraton pointed out, "most of the things which are of this nature will also suit a cabin or sea voyage". [15]

Another major contributory factor to the increased output of compact and multi-purpose furniture (Fig.8) many of which incorporated different mechanical devices as a result of the Industrial Revolution, was the population explosion in England, beginning in the 1780's. This boom led to a fifty per cent increase in numbers between 1801 and 1821 and put enormous pressure on living space in the cities, especially London.

Designs and 'Patents' of Invalid Furniture During the Last Forty Years of the Georgian Period.

Medical science gave particular stimulus to competitive inventiveness and in the last forty years or so of the Georgian period (c.1790-1830), more designs for beds, chairs and sofas (using metal frames, joints and rods) more comfortable and hygienic bedding materials were officially registered at the Patents Office.

There were also many unofficial 'patents' of the same kind, as the term patent became a fashionable label for any article which could claim novelty of construction or material. Many 'patent' chair makers concentrated on reclining chairs and sofas rather than actual wheelchairs as the aim of most manufacturers was not only to supply

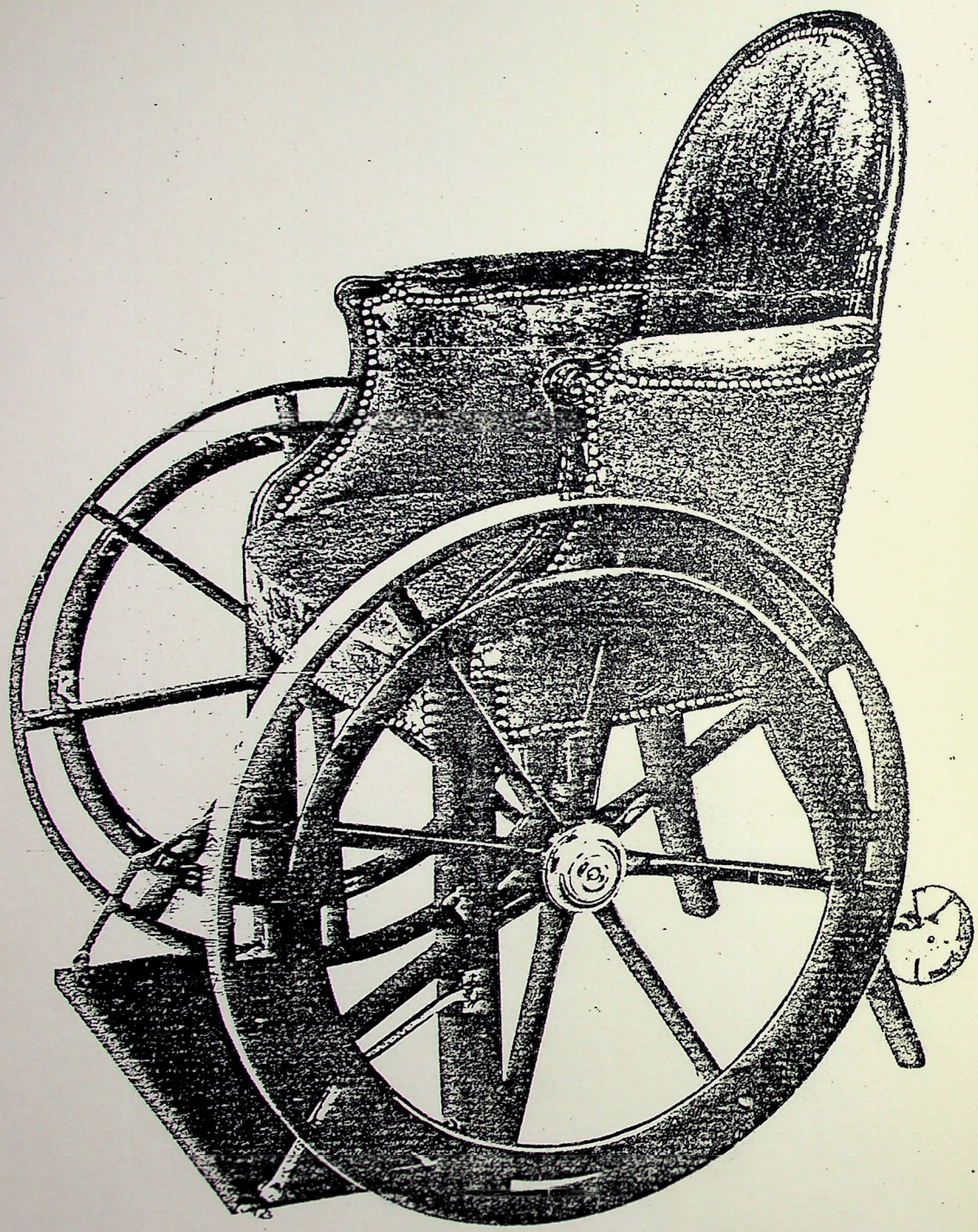


Fig 8. A mahogany wheelchair with brass fittings of c. 1810.

convenient and practical devices to aid comfort and mobility but to retain, where possible, the normal appearance of furniture for everyday use.

Metal joints were introduced to wooden frames and in some cases wood was discarded altogether in favour of metal (this was more applicable to beds than sofas and chairs). The method considered best at the time was to use hollow tubes of brass, iron or steel, and between 1812 - 1831 seven patents for such frames were registered.[16] These tubes were light and cheap as well as clean, "will not harbour vermin" is a recurrent phrase in their specifications. In 1828, Samule Pratt patented his wire springs of iron or steel twisted into circular or triangular coils. Clean, strong and comfortable, they were an immediate success and enthusiastically received. They were soon applied to seating furniture, producing the deep, heavy and comfortable upholstery so typical of the Victorian interior, although they were originally intended for mattresses.

"Beds, sofas and machines" for invalids figured in eight patents between 1794 - 1839.[17] Their object was to raise the patient from a lying to a sitting position, or raise his legs, or lift him completely clear to change the bedlinen.

The inventions had in common various forms of levering mechanisms usually worked by a worm-wheel gear drive; the mattress and board beneath were in three movable segments, related to the back, thighs and legs, and the appropriate section was raised to suit the patient's needs. The problem was to keep the mechanism within a reasonable dimension. George Paxton's patent bed of 1812 had a frame which performed no less than ten movements. It had a structure of two uprights at each end of the bed joined above by a cross-piece. One shaft and handle carried out all the movements, and to raise the patient clear, there was an extra outer frame covered with a sheet or straps which were fastened to knobs at the sides.

Other patents incorporated more discreet mechanisms, and a particularly notable success was the "sofa, or machine for the ease of invalids"

patented by Samuel James in 1813. This was an elegant Regency sofa: a toothed quadrant worked by a handle lifted half the mattress into a completely upright position- a smaller toothed bar, worked by another and smaller handle, raised the rest of the mattress into an inverted "V". This piece has been held to mark a decisive stage in furniture history, as it represents the introduction of an era of adaptability in furniture design.

In his Mechanization Takes Command (1948), a pioneer study of the influence of industrial production on furniture, Siegfried Giedion picks James' invention as a landmark, illustrating his thesis "that furniture suitable to the informal posture between lying and sitting was first used by the sick". [18] This principle of adaptability could not only be applied in more complicated forms to medical needs, as in William Newton's 'Surgical chair bed' patented in 1828, which made elaborate arrangements for the patient's physical functions, but was of course also transferable to everyday use, as in Minter's 'reclining chair' patented in 1830, with 'self adjusting leverage on the back and seat'. [19]

William Pocock

William Pocock appeared in trade directories between 1802 and 1824, giving his address as 26 Southhampton Street, Strand. He was a prominent and self-made furniture maker of the first quarter of the nineteenth century, providing many examples of invalid furniture (Fig.9) and of furniture adapted from it for domestic use.[20] Pocock was perhaps best known for his 'boethema' or rising mattress (taking its name from the Greek word meaning 'relief') which was fitted to a special bed frame or sofa containing a levering mechanism operated by a handle.

As early as 1814, Pocock issued a large double page advertisement with a surmounting representation of the Royal Arms (Fig.10). There are ten of his pieces illustrated and some descriptive text. It was found among Foreign Office papers at the Public Records Office in London, dealing with the British Embassy in Spain 1814, where it no doubt was included for its interest to serving invalid officers in the Penninsula. Included is a wheeled invalid chair with adjustable

back and reading desk and a reclining easy chair with double footstools. Also in the advertisement, but not illustrated, was a list of other pieces with beautifully brief descriptions: "Go-to-Bed Chairs to assist infirm persons in going to bed and getting up - Cradle beds to change and remake the Bed without disturbing the Invalid, Vibrating Pendulum Beds to Swing and give gentle Exercise, or lull them to sleep". In addition to these articles (many of which were described as 'patent' though Pocock's only official patent was one of 1805 for an extending dining table), was stated that every article "from the plain and useful to the most costly and magnificient" was guaranteed by the "Goodness of the Workmanship and Materials", and most of the illustrated inventions, so runs the article, "have been honoured with His Majesty's immediate patronage".

To the above are added three more illustrations on his trade cards (Fig.11). The trade cards show a 'patent elevating library or office table' and the boethema rising mattress'. Both the table and the 'boethema' were elevated by turning a handle at the side of the pieces.

Novelty for novelty's sake must have been a constant temptation to the makers of patent furniture, but one which most of Pocock's illustrated pieces show he avoided. Pocock died on the 17th April 1835, aged almost eighty-five, and active until nearly the very end.

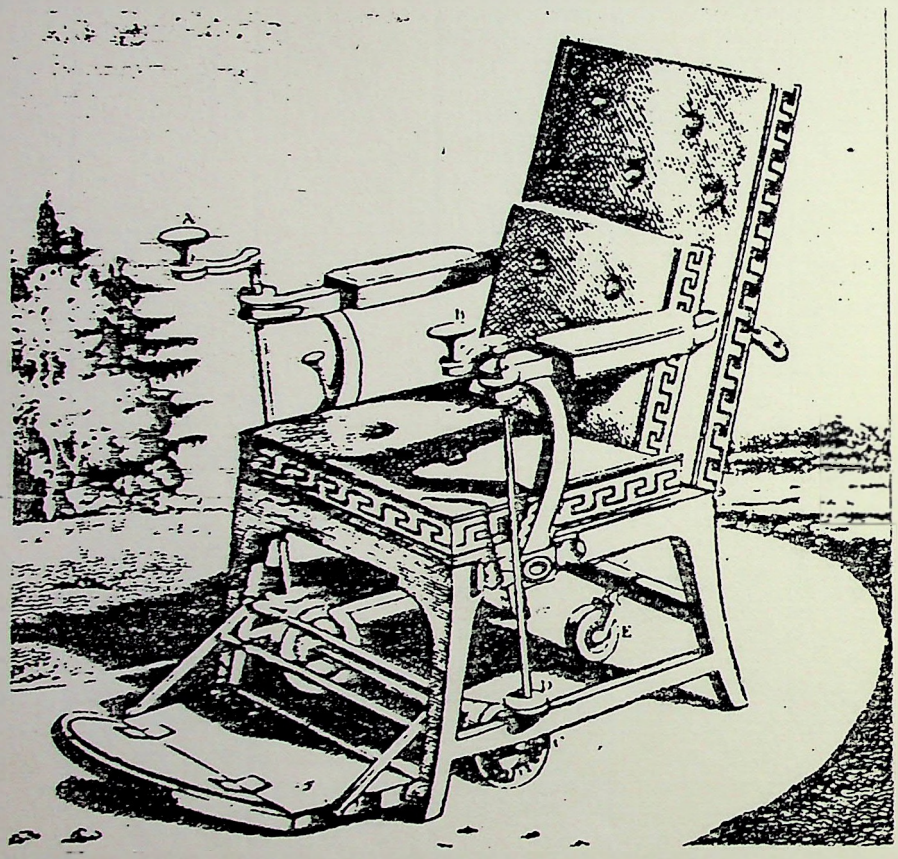
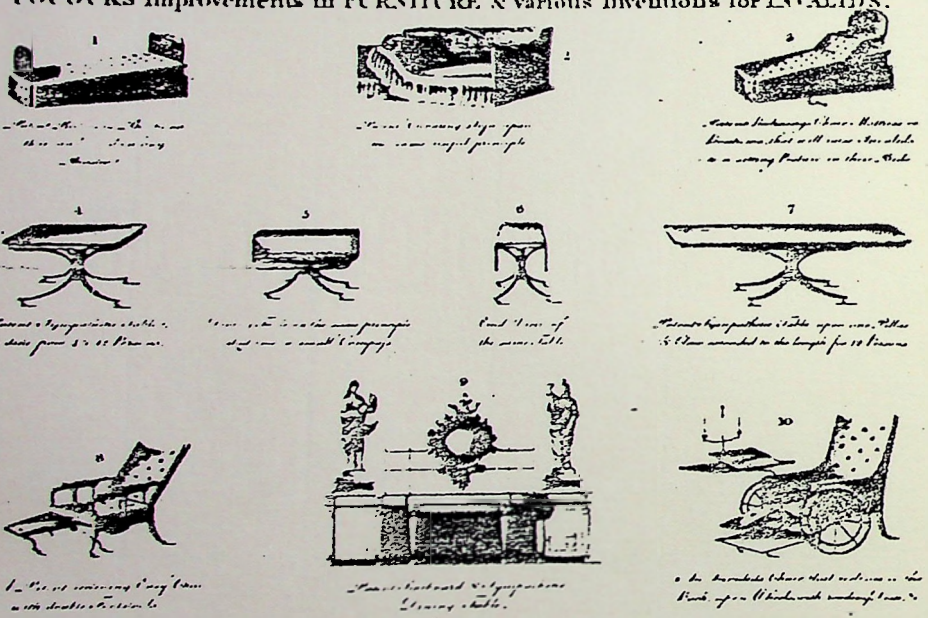


Fig.9 A mechanical 'Gouty Chair' designed by William Pocock of 26 Southampton Street, Strand, illustrated in 'Ackermann's Repository of Arts'. 1811.

By Her Majesty's Royal Letters Patent.

POCOCK'S Improvements in FURNITURE & various Inventions for INVALIDS.



(Most of the above Inventions.)

have been honored with His Majesty's immediate Patronage.

Mess^rs Pococks manufacture every Kinde of Cabinet & Upholstery Furniture, & set up Houses with Economy, on the shortest notice, & in a superior style of Elegance & Fashion.

SOUTHAMPTON HOUSE, No. 26, SOUTHAMPTON STREET,

COVENT GARDEN.

Fig. 10 (i) Double page advertisement for Pocock's furniture, 1814
Public Records Office.

Patent Sympathetic and Self-acting Dining Tables,

FOR GENERAL USE.

Which One Person can, with Ease and Facility, enlarge or diminish to the size required, in a Manner perfectly new. The self-acting Tables also are completely novel and striking. The Construction so astonishingly simple, and the Scale so variable as to suit either the Cottage Ornée, the festive Board of the hospitable Mansion, or the extensive Entertainments of the Nobility and Men of Fashion. Can be made to unite with a fashionable Sideboard, and form an elegant Piece of Furniture for a Dining-Room.—See PLATE, *Nos. 4, 5, 6, 7, and 9: And yet can be made so portable as to go with the Baggage of a Regiment for the Officers' Mess.*

The Sympathetic Dining Tables *very much exceed all others yet offered to the Public, as will be seen upon the first View of its Movements in changing from one Size to another; which one Person performs with as much Ease and Facility as two Persons can any other, except the Self-acting Tables, which are the true* Ne plus ultra; *nor can it be reasonably expected they will ever be excelled.—The Persons sitting at this Table, if they wish to enlarge it, need only draw one of the Ends of the top towards them, and the other will recede from them, till there is room sufficient for another Leaf between, when one instantly rises and fills up the Space, without any assistance from the Person enlarging it. In Fact it needs only to be seen to be approved, being completely simple and effectual to all the Purposes intended, and cannot be put out of Order.*

The Patent Biethema, or Rising Mattresses,

Are for the Use of Invalids to raise them up in their Beds; or for any Person accustomed to sit up while in Bed; can be laid upon any Bedstead, and is so constructed as to be applicable to a Sofa. —*See* PLATE 1, 2, *and* 3.

Merlin's Reclining and Gouty Chairs,

Are so improved as to have an elegant and modern Appearance; and Persons by the Use of the Foot-stools can recline in them or travel from one Room to another.—See PLATE, *Nos.* 8 *and* 10.

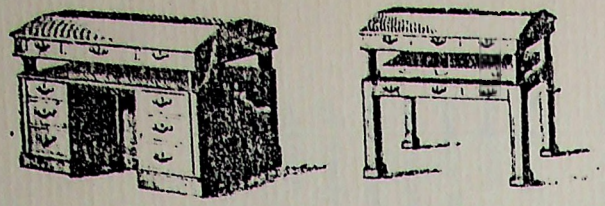
The Patent Sofa Beds,

Make a comfortable and convenient Sofa and Bed, suitable either for Camp or Barracks, or on Board a Ship, or even for an elegant Drawing-Room; and yet are very portable by folding into a very small Compass for the Convenience of Carriage. They have been highly approved by distinguished Officers of the Army and Navy.

We also manufacture curious Treble Reflecting Looking-Glasses *of new Construction*—Library Tables *to rise to suit either a sitting or a standing Posture for Reading or Writing*—Go-to-Bed Chairs *to assist infirm Persons in going to Bed and getting up*—Cradle Beds *to change and remake the Bed without disturbing the Invalid*—Vibrating Pendulum Beds *to swing and give gentle Exercise, or lull them to sleep; and many other Inventions too numerous to mention in our present Limits.*

And also every Article of Cabinet or Upholstery Furniture, from the plain and useful to the most costly and magnificent, and pledge ourselves the Goodness of the Workmanship and Materials, either in the general Line of Furniture, or those we make by exclusive Privilege of His Majesty's Patent, shall be of the best Quality, and have no Doubt of being as successful in giving full Satisfaction to those Ladies *and* Gentlemen *who may yet honour us with their Commands, as those we have been already favored with.*

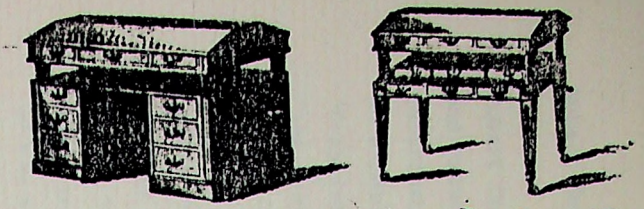
1801.



Pocock's Patent Library *or* Office Table
WAREHOUSE,
No. 26, Southampton Street, Strand.

Where also may be had the Patent Boethema or Rising Mattrefs

D. 2. 625

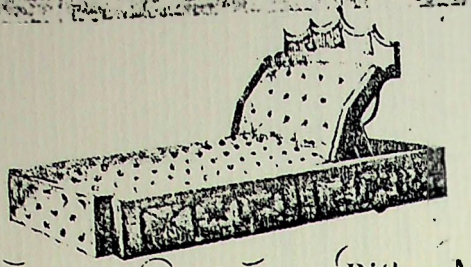


Pocock's Patent Library *or* Office Table
WAREHOUSE,
No. 26, Southampton Street, Strand.

Where also may be had the Patent Boethema or Rising Mattrefs.

D. 2. 624

1803



Pocock's Patent Boethema *or* Rifing Mattrefs
WAREHOUSE,
No. 26, Southampton Street, Strand.

Where alfo his Patent elevating Library or Office Table may be feen.

W. Pocock,
Upholfterer, Cabinet Maker & Undertaker,
No. 26,
Southampton Street, Strand.

The Warehouse for his Patent Boethema Mattreffes, Patent Library or Office Tables, Patent improved Sofas, Couches, Easy Chairs, Reclining Chair Beds, Carving Chairs, Rising Stools, & various other Articles of useful mechanical Furniture, peculiarly adapted for Ease, Comfort & Repose, and which give that most Relief, the change of Position only can afford.

27.

Fig.11 Two of Pocock's trade cards (fronts and backs), British Museum.

Robert Daws

Robert Daws was first registered as an 'Upholsterer, Cabinet and Patent Chair Maker' during the early 1820's, but later he described himself as a 'Patent Recumbent Chair Manufacturer'. An example of his reclining chair was illustrated in J.C. Loudon's 'Encyclopaedia' in 1833 (Fig.12). The description reads - "the position of the back of this chair can be varied at pleasure, and the projecting part in front can be elongated or adjusted at any slope. When it is not to be used as a reclining chair, the back can be fixed upright; and the front projection slid in, so as to produce the appearance of a common easy chair". All Daws' chairs bore a label describing the "manner of using R. Daws' Patent Recumbent Easy Chair" and the assurance "respecting the permanence of the principle of this chair but little need be said, since R. Daws is willing to make OATH that the least derangement has not to his knowledge averaged one in FIVE HUNDRED during five years".[21] These chairs, with adjustable backs and sliding footrests were a standard model for many manufacturers during the first half of the nineteenth century. Variations included laterally moving wings and arms and adjustable reading or lamp stands.

Most of the surviving invalid furniture we have dates back from the Regency period, 1800 - 1830, and reflects a good understanding of simple mechanical engineering, allied to a refined appreciation of Neo-classical Regency design. The existence today of many reclining and invalid chairs of Robert Daws and some predecessors, is proof of their successful attempts to produce comfort and convenience without loss of elegance.

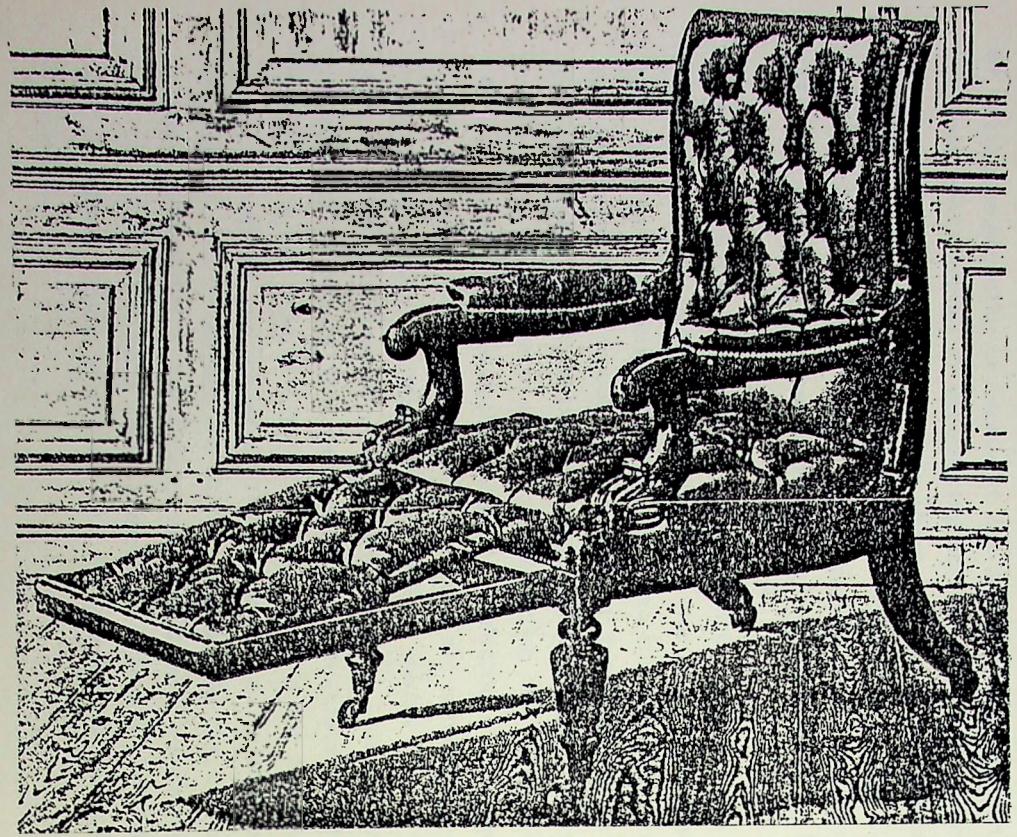


Fig.12 A Robert Daws 'Patent Recumbent Easy Chair' bearing the Daws label and the date, January 1833. Mahogony with leather upholstery.

Invalid Furniture in the Victorian Period

After 1830 there were many registered invalid furniture makers but later developments in this type of furniture, as in furniture generally, proved unfortunate. The early functional precision of much of the invalid furniture, the union between cabinet making of refined simplicity (a legacy of the Sheraton era) and metallurgical skill allied to engineering accuracy was lost beneath the rising tide of elaboration in which the desire for comfort and novelty for its own sake were decisive factors. The Victorian love of comfort and the fashion for deeply-stuffed upholstery also increased the size and clumsiness of many pieces (Fig.13).

Despite numerous advertisements in nineteenth furniture and trade journals (Fig.14) for an almost excessive variety of complex day beds, couches and chairs (Fig.15), it seems that very few examples have outlasted their occupants. A similar fate appears to have taken the large number of outdoor wheelchairs produced by specialist carriage and perambulator manufacturers during the last decades of the century (Fig.16 and detail, Fig.17). Although more varied in design and use of materials, the basic form and mechanical structures showed surprisingly few advances on the Bath chairs of the previous century. This is true of designs seen (even as late as 1900 in England) in the advertising section of The Illustrated London News, 1900 (Fig.18 and detail, Fig.19). Once again a war had influenced the sale, variety and number of invalid comforts. 'Wounded Soldiers will derive untold comfort and aid to recovery by the use of CARTERS' APPLIANCES. The Benevolent cannot make a more appreciable gift'. Also in the same advertisement is written: 'AMBULANCES - Hand or Horse. Best in the World! for the Street Accident Service of London'.

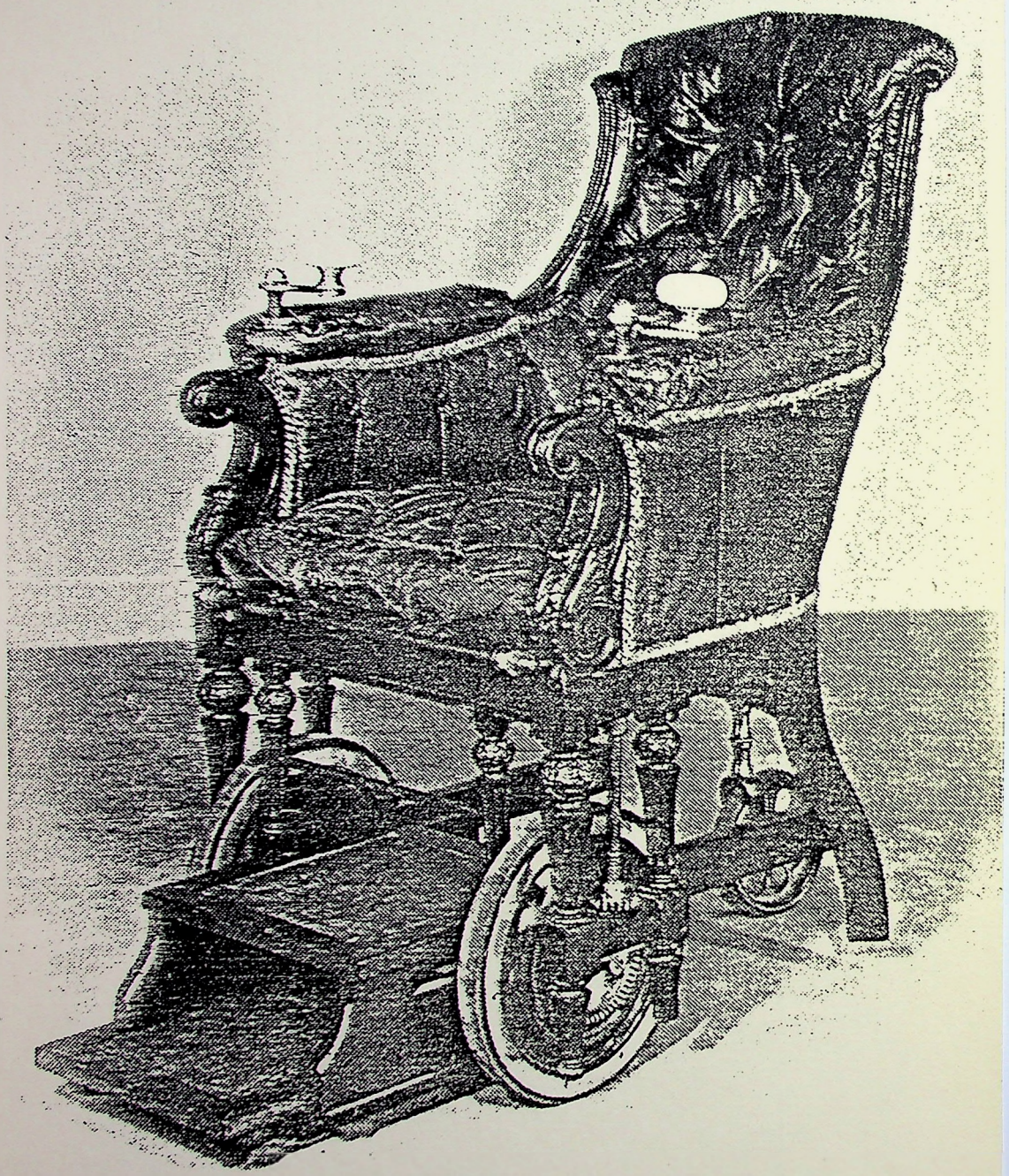


Fig.13 A mahogony 'Gouty' Chair of c.1850 with deeply-buttoned leather upholstery and ivory turning handles.

NOS. 1, 2, and 3, show J. ALDERMAN'S PATENT GRADUATING ELASTIC SPINAL and GENERAL INVALID COUCH, which is fitted up with two, three, or four distinct graduating actions, so that an invalid can be adjusted imperceptibly to any position without being touched by the nurse, and free from all pressure, that being avoided by his Elastic Ventilating Mattress and his Patent Elastic Adjusting Foundation; so that a patient cannot become bed-sore by long confinement.

No. 4, 4, is J. A.'s Improved Spinal and General Invalid Couch and Carriage. The Couch has three distinct movements, so that a patient can be placed in any position; it has also a Shifting Stand for the room, upon large easy castors, so that the invalid can be lifted with the Couch from its stand, placed upon the Carriage, and go out for an airing when required, without being touched.

No. 5, 5, is J. A.'s Patent Graduating Elastic Self-adjusting Invalid Chair. This Chair, like the Couch, is made to follow nature in every respect, as the back, the arms, the seat, and the leg-rest are made to work at the same time, so that not a muscle of the patient need be disturbed. The arms are also made to put on and off in an instant, so that the patient can get on and off from either side while the leg-rest is out.

No. 6 is J. A.'s improved Self-Propelling Chair, which renders an invalid perfectly independent, being able to run from room to room without any assistance.

No. 7 is J. A.'s improved Exercising Horse, which he fits upon a variety of ways, so as to give any amount of exercise.

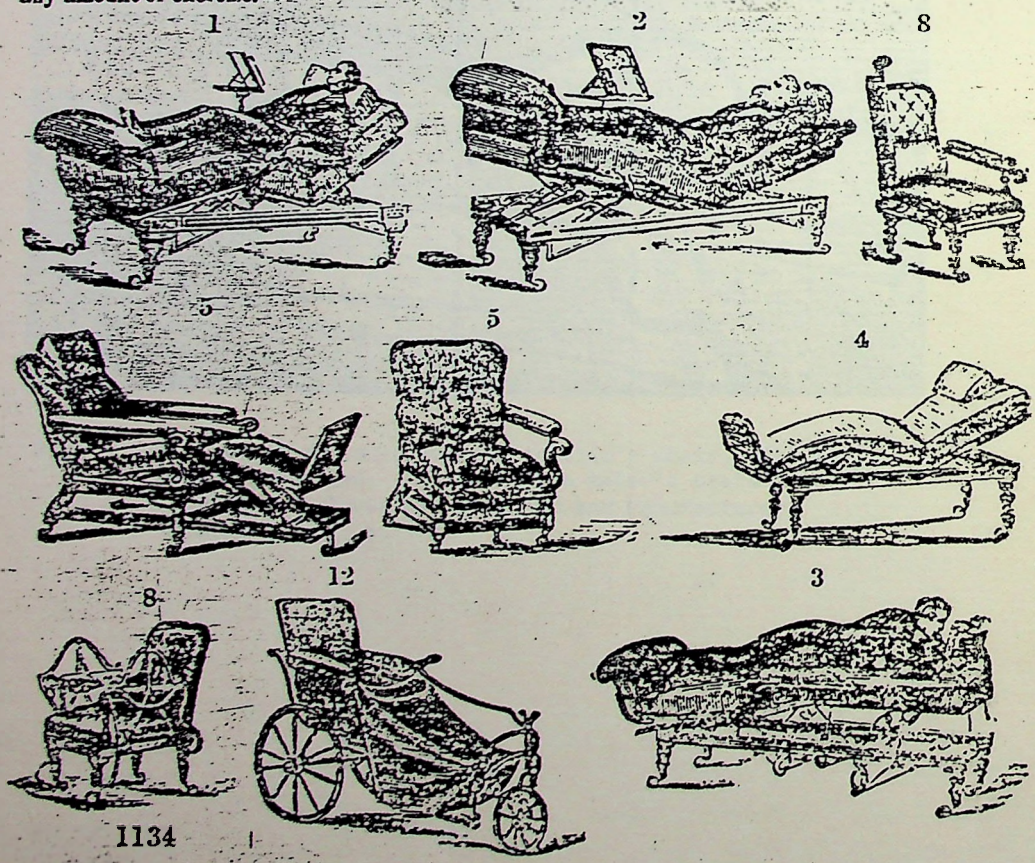


Fig.14 An advertisement for invalid couches and wheelchairs(Bath chairs and Brighton chairs)' from the London & Provincial Medical Directory,1861.

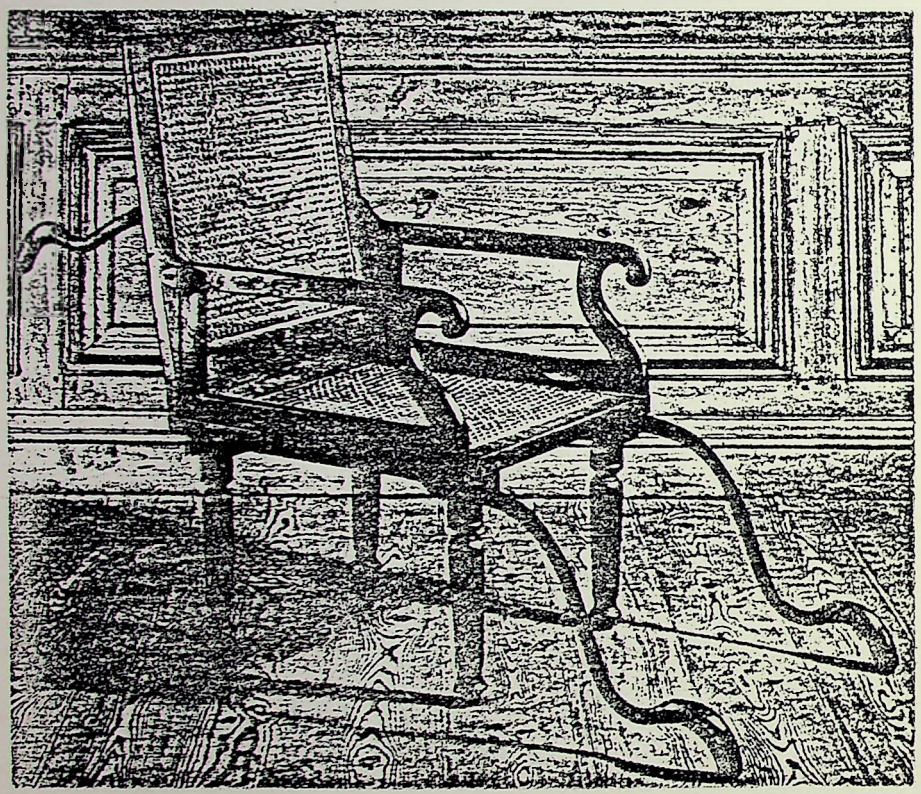


Fig.15 A rosewood portable folding invalid's chair, with metal carrying handles. It bears the maker's plate of J. Alderman, Inventor, Patentee and Manufacturer, 16 Soho Square, c. 1860

Fig.16 A page from 'The Illustrated London News', advertising section, May 12, 1900.

Fig. 17 Detail from Fig.16.

BEECHAM'S PILLS

FOR ALL

Bilious and Nervous Disorders,

Sick Headache, Constipation,

Wind and Pains in Stomach, Impaired Digestion,

Disordered Liver, and Female Ailments.

Contains 63 Pills.

The Sale now EXCEEDS SIX MILLION BOXES per annum.

BEECHAM'S TOOTH PASTE

RECOMMENDS ITSELF.

In Collapsible Tubes. Of all Druggists, or from the Proprietor for One Shilling. Postage Paid.

ADAMS'S FURNITURE POLISH.

THE OLDEST AND BEST.

"The Queen." [illegible]

Unequalled for its Brilliance and Cleanliness.

It Cleans, Polishes, and Preserves Furniture, Saves Time, Prints Leather, and Varnished or Enamelled goods.

VICTORIA PARK WORKS, SHEFFIELD.

NESTLÉ'S FOOD

THE BEST OF ALL FOODS FOR INFANTS AND INVALIDS.

VERY NOURISHING AND PALATABLE. Does not Curdle in the Stomach.

INVALUABLE FOR BABIES AT THE TIME OF WEANING

COUNSEL'S OPINION

Mr. LAMPLOUGH: "Well, Sir, in your opinion, have I said more for my PYRETIC SALINE than its merits deserve?"

LEADING QC.: "No, Sir, you have not. It is my deliberate opinion, after many years' experience, that for keeping the body in health, the head cool, and the mind clear, there is nothing to be compared with

LAMPLOUGH'S PYRETIC SALINE."

The invaluable preparation of over fifty years' standing now in use of all Chemists everywhere.

DON'T ACCEPT ANY SUBSTITUTE.

E. & J. Burke Ltd

CAPITAL £1,100,000

DUBLIN WHISKEY.

REVIVAL & REVOLUTION IN IRISH WHISKEY.

The conviction long existing in the trade is now steadily growing amongst consumers that a blend of good whiskies is superior in every quality to the product of one Distillery, which is in most cases too pronounced in its flavour, &c., to be palatable to the majority of consumers.

A FEW FACTS ABOUT BURKE'S WHISKEY:

It possesses a soft mellow flavour.

Especially suitable to those who do not like strong flavoured whiskies.

The Whiskey, being light and easily assimilable, is especially suited for people of sedentary habits, weak digestion, or bilious temperament.

Quality and age guaranteed.

It is well adapted for using with mild and aerated waters, as is now customary.

The extreme softness, mellowness, and fine character are produced by age, high quality, and judicious blending.

Bottled in Bond in Dublin. ESTAB^D 1849.

40/- per Case (2 Galls.), Carriage Paid.

Orders will be executed from the Head Office, or from our accredited Agents in every part of the World.

E. & J. BURKE, DUBLIN.

THE BEST JUDGES OF CIGARS

BENSON'S, 61, St. Paul's Churchyard, London.

THE WAR.

MAKER TO The Queen, Princess of Wales, and Empresses of Russia & Germany

CARTER

Illustrated Catalogues POST FREE.

TWO GOLD MEDALS & 4 AWARDS

6A NEW CAVENDISH ST. PORTLAND PLACE, LONDON, W.

LITERARY MACHINE

INVALID COMFORTS

Adjustable Couches, Beds, from £1 15s.

Bed Rests 7/6
Leg Rests 10/-
Crutches 10/6
Bed Tables 12/6
Commodes 20/-

Chairs from £2 2s

Breakfast-in-Bed Tables from £1 10s.

Self-Propelling

AMBULANCES—Hand or Horse. Best in the World!

BATH CHAIRS from £1 10s.

Adjustable Bath Chair or Spinal Carriage.

Fig. 18 Page from 'The Illustrated London News' April 28, 1900.

Fig. 19 Detail from Fig.18.

Continued Development of the Wheelchair to the Present Day

The leadership in mechanical furniture passed from England in the latter half of the nineteenth century to America. In a catalogue in 1871 of a Connecticut manufacturer we see a chair with a caned seat and back, two wheels large enough for self-propulsion and a thin small wheel in the front under the foot board. Some wheelchairs at this time even had handrims.

Yet the wheelchair was still awaiting its last important improvement before resembling the hospital chair of today: its large wheel previously made of wood was replaced by the wire spoked wheel. The invention is attributable to Starley, who was also the inventor of the 'penny farthing' in 1870, and later of the simple gear allowing the wheel to be turned twice for each revolution of the pedals. Starley decided to reduce the weight of the clumsy 'velocipedes' that used the heavy iron rimmed wheels. He lightened the wheels by making them of iron with wire spokes under tension. His spokes were a single reel of wire looped through holes in the rim and the hub to which he applied tension by screwing up the threads. This arrangement was improved further by the introduction in 1874 of eyed and threaded nipples to hold the spokes individually. Later in the same year, Starley developed the concept of tangental spoking - as distinct from radial spoking - to ease the sideways stress on the spokes.

These improvements were applied to the wheelchair as their makers their tyres directly from the bicycle manufacturers. In the 1890's bicycle sales and membership to cycling clubs such as the League of American Wheelmen were at their highest. By this time the bicycle craze was in full swing on both sides of the Atlantic.

It took another few decades, with the development of the automobile, and the accompanying improvements in the roads, to achieve one of the most important steps in the evolution of the wheelchair - the mass production of a collapsible chair of light weight. The United States have been particularly successful in the production of the folding four-wheeled types since the 1930's, and these designs have served as models in many other countries (Fig.20).

Powered chairs, first made available in 1964 by the D.H.S.S. in England, were designed for the weak and elderly disabled people, for others with muscular dystrophy, multiple sclerosis and some amputees. Motor and steering are generally powered by a 12V battery and the charger (240V AC supply) concealed with the battery in a glass fibre casing beneath the seat. The main limitations of these chairs are their inability to cope with steep slopes or rough ground and their cumbersome size, which makes transportation difficult. They do, however, provide a limited mode of transport for many who, due to their disability, would otherwise need an attendant. In this country powered chairs are only supplied by the Health Boards to persons without the use of the upper limbs.

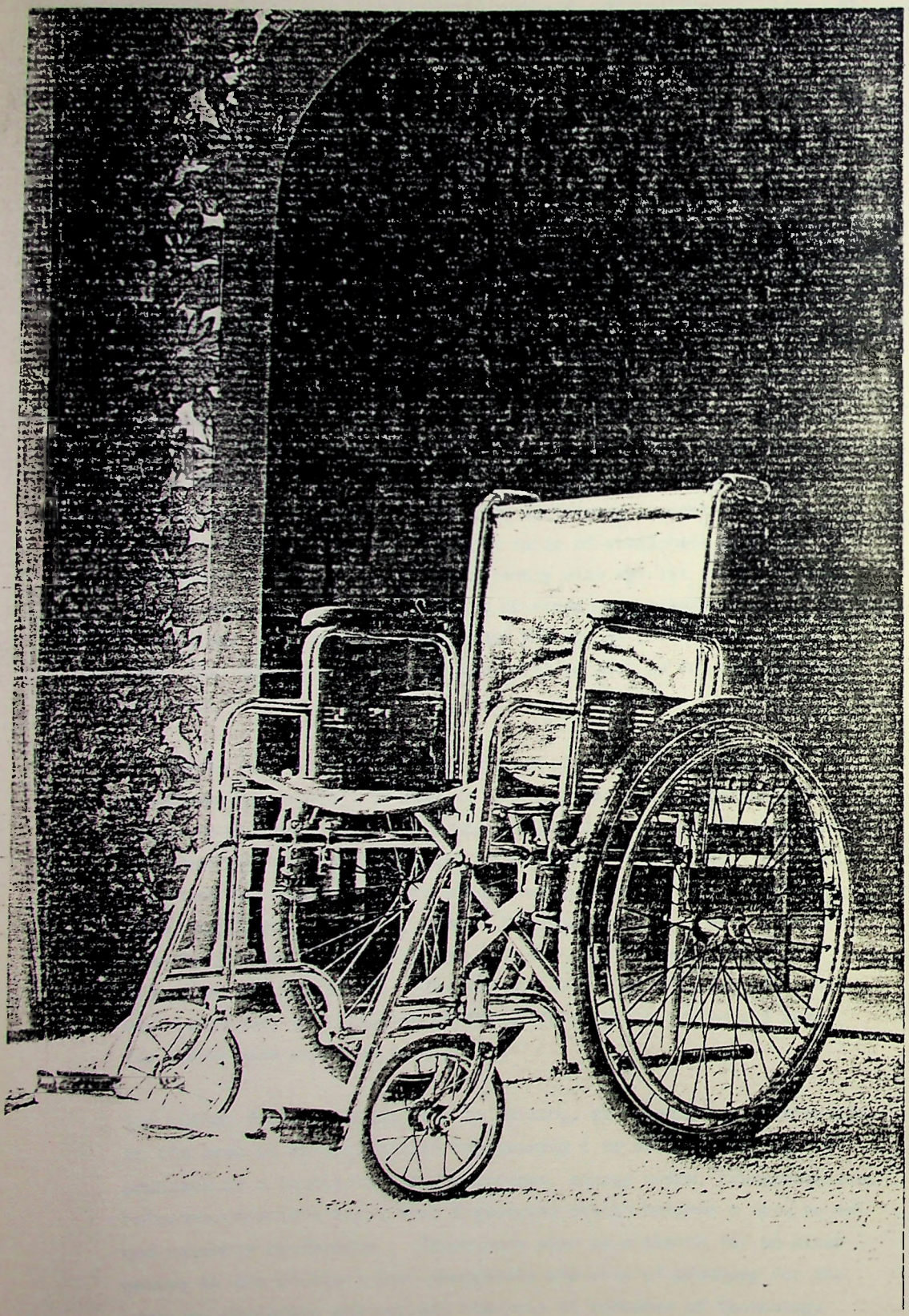


Fig. 20 Standard Model of lightweight folding wheelchair, 1980.

Conclusion

With the increased range of production techniques available and in particular the giant steps that have occurred in the field of polymer technology (much attributable to the N.A.S.A. Space Research Programme) the design of the wheelchair and its production are constantly under review. Progress has been made in most countries towards a safer, lighter, stronger, more stable and compact wheelchair but the most impressive fact in the history of the wheelchair, is what its users have made of it.

Advances in medicine saved many who in former times would have died and with the increase in the number of those needing a wheelchair, this object has become familiar to everyone, not only its users. Considering also the increased life expectancy in most countries today and bearing in mind that the ratio of wheelchair users to the total population rises consistently with age (it is estimated that a person aged 75 and over is 25 times more likely to be a wheelchair user than a person under the age of 20)[22] one imagines that the need for improved designs will be with us for many decades to come.

It can be seen in previous sections of this paper that design developments were all located in the more fortunate nations (i.e. those favoured by their geographical location or historical circumstances) and not the peripheral or developing countries. However, the need for wheelchairs and other invalid aids in these countries is a particularly pressing one. The disabilities in most cases are the results of malnutrition, and the lack of basic medical attention and education. The sad but true fact still remains that with a more just distribution of the world's wealth the actual need for these aids would be negligible.

The author feels strongly that in working, or in some way contributing to the area of Rehabilitation Engineering (or design tackling the problems of a country's infrastructure: energy needs, transportation, telecommunications etc.) that industrial design becomes a more honest and valuable profession. There must also be a search for an alternative to the politics that monopolise the role of producer for the advanced countries and entrust the role of consumer of technology

and design to the peripheral countries.

It is in this direction that the author would like to see the future design and development of the wheelchair take, utilizing local skills, labour and materials. However, wheelchair improvements will undoubtedly continue to extend with its use, hopefully making many disabilities less of a handicap. Intensive rehabilitation of disabled adults and children continues to bring them from seclusion into more contact with the community, and their mobilization' in turn stimulates further improvements to the wheelchair.

FOOTNOTES*

1 Encyclopaedia Britannica, Micropedia, Vol.X,p.643

2 Encyclopaedia Britannica, Micropedia, VolVI,p.266

3 C.P. FITZGERALD, Barbarian Beds: The Origin of the Chair in China, (London, 1965) Ch.1, p.1.

4 T.K. DERRY and T.I. WILLIAMS, A Short History of Technology, (New York and Oxford, 1961)

5 J. LHERMITE, Le Passetemps, (Antwerp, 1890), Vol.I, pp.257-258 (Folio 156-157 of the original manuscript, 1595).

6 Information from the Director, Municipal Libraries and Victoria Art Gallery, Bath, England.

7 Information from KAMONETZ, Herman L, "A Brief History of the Wheelchair", Journal of the History of Medicine (April) pp.209-210.

8 Dorothy GEORGE, London Life in the 18th Century, (1930) Chapter I, 'Life and Death in London', pp.21-61 (esp.pp. 51-5)

9 Ibid., LETTSOM., p.51 and pp.336-7.

10 L.O.J. BOYNTON, "The Bed Bug and the 'Age of Elegance' ", Furniture History, Vol.I, 1965 pp.15-31.

11 Excerpt from 'London Labour and the London Poor', Mayhew's London, edited by Peter Quennell (London 1949), pp.429-31.

12 Ibid., Mayhew's London, pp.428-9.

* Run continuously through the entire paper.

13 Annotated by T. CARLYLE and ed. by A. CARLYLE, New Letters and Memorials of Jane Welsh Carlyle, 2 vols., (London,1903), i.pp.52-3.

14 Ed. T. CARLYLE and J.A. FROUDE, Letters and Memorials of Jane Welsh Carlyle, 3 vols., (London,1883), i. p.129.

15 T. SHERATON, Cabinet Dictionary, (London, 1803).

16 Metal Tube Patents (date, patentee and patent number): 1812, Steinhoeuser, 3533; 1812, Thomson, 3560; 1817, Benjamin Day, 4132; 1826, Thomson, 5403; 1826, William Day, 5410; 1827, Winfield, 5573; 1831, Winfield, 6206.

17 These eight patents are: 1794, Bentley, 2005; 1810, Parker and Cluley, 3387; 1812, Paxon, 3397; 1813, James, 3744; 1823, Rawlins, 4786; 1828, Newton, 5605; 1835, Cherry, 6746; and 1839, Thomson, 8320.

18 S. GIEDION (Second Edition, 1955) describes and illustrates James' patent, p.410, fig.243.

19 1828, Newton, 5605; 1830, Minter, 6034; Giedion refers p.408, to Newton's patent and p.454, fig. 288 to Bentley's (1794).

20 Edward T. JOY, "Pococks - the Ingenious Inventors". The Connoisseur, vol. 173, no.696, (February, 1970), pp.88-92.

21 Gillian WALKING, "For the Comfort of Invalids", The Connoisseur, (December, 1979), p.261

22 Selwyn GOLDSMITH, Designing for the Disabled,(Third ed., R. Publications Ltd., 1976) p.131.

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6. Patents Office, London.
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8. Trinity College Library, Dublin. (Berkeley & Lecky Libraries).
9. Ulster Folk and Transport Museum, Down.
10. Victoria and Albert Museum, London.
11. Walking, Gillian (Journalist) 'The Connoisseur', London.